

LIFE HISTORY OF *ATTACUS ATLAS* L. (LEPIDOPTERA: SATURNIIDAE)  
ON *LITSEA MONOPETALA* JUSS. IN NORTH-EAST INDIA

B.N. SARKAR<sup>1,3</sup>, B.C. CHUTIA<sup>2</sup>, J. GHOSE<sup>1,4</sup> AND A. BARAH<sup>1,5</sup>

<sup>1</sup>Central Muga Eri Research & Training Institute, Central Silk Board, Lahdoigarh 785 700, Jorhat, Assam, India.

<sup>2</sup>Department of Zoology, Nowgong College, Nagaon 782 001, Assam, India. Email: bhuban08@yahoo.co.in; bhuban78@gmail.com

<sup>3</sup>Email: bnsarkarcsb@yahoo.com

<sup>4</sup>Email: jghosecsb@yahoo.co.in

<sup>5</sup>Email: anukul\_barah@rediffmail.com

*Attacus atlas* L., the source of 'Fagara Silk', is a wild silk moth of north-east India. The detailed life history, bionomics and rearing performance of *A. atlas* in relation to a newly reported food plant *Litsaea monopetala* Juss, which is the major food plant of Muga silkworm *Antheraea assamensis* Helfer, has been described in the present study. Life cycle of *Attacus atlas* silkworm has five larval instars. Each larval instar exhibits distinguishing colour variation and tubercular arrangement. The first instar larva measured 1.12 ± 0.28 cm, 0.19 ± 0.07 cm and 0.017 ± 0.02 gm in length, breadth, and weight, respectively, while the fifth instar larva measured 12.06 ± 0.82 cm, 2.08 ± 0.11 cm and 37.08 ± 1.22 gm in length, breadth and weight. Wing span of 19.1-25.5 cm in male, and 20.9-27.4 cm in female moths was recorded. The embryonic period and total larval duration were 10.8 ± 0.82 days and 41 ± 2.94 days, respectively, while pupal period of 20.4 ± 1.14 days in male, and 21.6 ± 1.14 days in female was recorded. The cocoon weight, shell weight and shell ratio were measured as 12.98 ± 0.89 gm, 1.698 ± 0.10 gm and 13.06% in male and 15.65 ± 0.66 gm, 1.790 ± 0.08 gm and 11.45% in female. Silk filament of *Attacus* cocoon is not reelable, but can be spun. The percentage of degumming loss, yarn yield and spinning waste were recorded to be 15.72, 30.41 and 53.87% respectively.

**Key words:** *Attacus atlas*, *Litsaea monopetala*, life history

## INTRODUCTION

*Attacus atlas* L. is a wild silk moth of north-east India and popularly known as 'Atlas moth' or 'Deo-muga' or 'Kotkari muga' in Assamese. It is widely distributed in South Eastern Asia, and abundantly found in India and the Indian Ocean Archipelago (Lampe 1984; Peigler 1989). The genus *Attacus* comprises of 15 known species (Peigler 1989) all over the world. Out of these, only one species, namely *Attacus atlas* is known to occur in India (Arora and Gupta 1979); the silk produced by *A. atlas* is called 'Fagara silk'. It is the largest silkmoth in the world. Fairly good numbers of records are available about the host plant diversity and distribution of *A. atlas* (Jolly *et al.* 1979; Chowdhury 1981; Lampe 1984; Peigler 1989; Thangavelu 1991; Bhattacharya *et al.* 2004; Singh and Suryanarayan 2005; Singh and Chakravorty 2006; Sahu and Bindroo 2007). The larvae of *Attacus* are highly polyphagous, feeding on a wide range of food plants. Arora and Gupta (1979) reported about 19 species of food plants from India alone. Chutia *et al.* (2009) recently reported three more species of host plants of *Attacus* from Nagaland, India. Saikia and Handique (2000) reported *Meyna laxiflora* (Kutkura) as the most preferred host plant of the *Attacus* silkworm and carried out detailed study on the biology and its commercial characteristics. *Attacus atlas* was hitherto not recorded feeding on *Litsaea monopetala* Juss (locally known as *Soalu*); therefore its life history and rearing performance

on this food plant is not known. Hence, a detailed study was conducted on the life history of *A. atlas* on *L. monopetala* Juss at Central Muga Eri Research & Training Institute, Central Silk Board, Lahdoigarh, Assam, to evaluate the commercial aspects of this lesser known silk moth.

## MATERIAL AND METHODS

Initially, two late instar larvae of *Attacus atlas* were collected from *Litsaea monopetala* in its natural habitat. The collected larvae were maintained on the food plant until pupation at Central Muga Eri Research & Training Institute. After pupation the cocoons were brought to the grainage house for seed production. After 22 days, the pupae metamorphosed into female moths. In absence of a male, a female moth was tied in the open at night for natural coupling with wild males successfully. The gravid female laid eggs up to 4 days. The eggs were incubated at room temperature. After 10 days of incubation period, the newly hatched larvae were released on the selected bushes of *L. monopetala*. Rearing was conducted under strict vigilance inside nylon net cover till the larvae matured. On maturity, the larvae were put in dry leaf for cocoon-making. 26 cocoons were harvested after 7-8 days of spinning. Of which, 16 cocoons were assigned for seed production and 10 cocoons were used for preliminary spinning trial. The cocoons were boiled in one litre of 10% sodium carbonate solution for 30 minutes for degumming.

The degummed cocoons were washed thoroughly in plain water to remove traces of alkali and then squeezed and dried to form a lump. Spinning was done in a CSTR motorized spinning machine. The entire process was conducted during May-July 2008, and the data pertaining to morphometric parameters, cocoon and yarn characteristics, physiological and production parameters were recorded simultaneously. In the immediate next generation, from August-October 2008, the above data was recorded again to confirm.

All data were recorded and five replications were conducted for each treatment. The mean values and standard deviations were calculated from computed values.

## RESULTS AND DISCUSSION

### Morphometric parameters

**Egg:** The eggs are oval, slightly flattened dorso-ventrally, pinkish grey with a brownish strip and polygonal punctuations. The eggs measure  $0.26 \pm 0.009$  cm and  $0.24 \pm 0.007$  cm in length and breadth, respectively, and weigh  $0.0078$  gm. The embryonic period is  $10.8 \pm 0.84$  days.

**1<sup>st</sup> Instar:** Head is smooth and black. Body is pinkish grey with brownish stripes. Black irregular markings can be seen on the inter-segmental region. Tubercles are whitish with black setae. The larvae measure  $1.12 \pm 0.28$  cm and  $0.19 \pm 0.07$  cm in length and breadth, respectively, and weigh  $0.017 \pm 0.02$  gm. The first instar larval duration is  $4.8 \pm 0.84$  days.

**2<sup>nd</sup> Instar:** The larva is dull white with black irregular markings and whitish tubercles. Deep orange elongated markings appear on anterior and posterior lateral region of the body. Prothoracic hood is soft, transparent and whitish in colour. The larvae measure  $1.96 \pm 0.40$  cm and  $0.72 \pm 0.29$  cm in length and breadth, respectively, and weigh  $0.323 \pm 0.10$  gm. This stage lasts for  $4.6 \pm 0.55$  days.

**3<sup>rd</sup> Instar:** The body is icy white to greenish with or without white fleshy tubercles. The length, breadth and weight of the larvae are  $3.82 \pm 1.14$  cm,  $1.2 \pm 0.22$  cm and  $3.612 \pm 0.98$  gm, respectively. The instar duration is  $6.6 \pm 0.55$  days.

**4<sup>th</sup> Instar:** The larva is greenish, and the whole body is covered with lime-like powder. The length, breadth and weight of the larvae are  $6.38 \pm 0.69$  cm,  $1.8 \pm 0.28$  cm and  $1.8 \pm 0.28$  gm, respectively. This instar lasts for  $10.4 \pm 0.55$  days.

**5<sup>th</sup> Instar:** The larval body is greenish, but covered with a lime-like sticky powder. The dorsal tubercles are whitish, whereas lateral tubercles are blue with black tips. The thoracic legs are conical and carry sharp distal claws. Each abdominal segment from 6<sup>th</sup> to 9<sup>th</sup> bears a pair of abdominal legs, which are fleshy and flat at the end. Terminal end looks like a disc

with a series of inwardly curved hooks arranged in a semi-circle. While dorsal tubercles project backward, the lateral tubercles project forward. Hampson (1892) first reported the characteristic tubercular arrangement in *Attacus atlas* L. The larva is about  $12.06 \pm 0.82$  cm,  $2.08 \pm 0.11$  cm,  $37.08 \pm 1.22$  gm in length, breadth and weight, and instar duration is  $14.2 \pm 0.84$  days.

**Pupa:** The pupa is dark brown in colour. It is  $3.44 \pm 0.48$  cm in length,  $1.96 \pm 0.28$  cm in breadth and  $11.29 \pm 0.79$  gm in weight in case of male, while it is  $5.12 \pm 0.31$  cm,  $2.56 \pm 0.15$  cm,  $13.86 \pm 0.65$  gm in length, breadth and weight in female.

**Moth:** The ground colour of the moth is red orange to tomato red. The basal area of the forewing has brown edges with red and pale black lines and middle area is red brown. A large transparent hyaline spot is present at the end of the cell with black edge. Apical area has yellow to pink shade. A yellow brown marginal band with a highly wavy black line is present in both the fore and hind wings. The wing span of the male and female moths is 19.1-25.5 cm and 20.9-27.4 cm, respectively.

The forewing and hind wing length of a male is about 9.5-11.9 cm and 7.6-8.1 cm, respectively. The hyaline area of forewing and hind wing is about 119 to 144 sq. mm and 135 to 176 sq. mm, respectively. The orange brown antenna is about 2.1 to 2.2 cm in length and 0.9 to 1.1 cm in breadth.

The forewing and hind wing length of a female is about 10.5-13.5 cm and 9.8-10.3 cm, respectively. Forewing and hind wing hyaline area is about 375-493 sq. mm and 368-475 sq. mm, respectively. The orange brown antenna is 1.9-2.0 cm in length and 0.3-0.4 cm in breadth.

### Cocoon and yarn characteristics

**Cocoon:** Cocoon characters like shell weight, shell ratio, and yarn characteristics like yarn colour, degumming loss and yarn yield percentage are of commercial importance as they reflect on silk quality. *Attacus atlas* cocoons are coarse and deep grey in colour with a prominent peduncle. The length, breadth and weight of cocoons are  $8.2 \pm 1.02$  cm,  $2.8 \pm 0.22$  cm and  $12.98 \pm 0.89$  gm in males, and  $9.24 \pm 1.18$  cm,  $3.46 \pm 0.32$  cm and  $15.65 \pm 0.66$  gm in females, respectively. The shell weight and shell ratio of cocoons are  $1.698 \pm 0.10$  gm and  $13.06 \pm 0.53\%$  in male, and  $1.790 \pm 0.08$  gm and  $11.45 \pm 0.65\%$  in female.

**Silk yarn:** 'Fagara silk' produced by *A. atlas* is grayish in colour. Degumming loss of *Attacus* cocoons is recorded to be 15.72% in sodium carbonate degumming (5 gm/l). From 100 gm of cocoon shell, 30.41 gm of hand spun yarn and 53.87 gm spinning waste were produced in the trial study. Preliminary studies register 30.41% spun silk recovery of

coarser count. Although yarn yield or, silk recovery percentage in *Attacus atlas* cocoons is less, there is possibility to enhance yarn yield by adopting improved softening device(s) to make it more economic and useful.

### Physiological parameters

**Metamorphosis:** *A. atlas* is holometabolous in nature. It undergoes complete metamorphosis and passes through four stages, namely egg, larva, pupa (cocoon) and adult (moth) during its life cycle.

**Moultinism:** The larva moults five times. When moulting, anterior part of the body remains suspended, prothoracic hood becomes stretched and protruding head is bent ventrally inward.

**Voltinism:** *A. atlas* is bi-voltine in habit in the climatic

condition of north-eastern region of India. It completes two life cycles, one during May-June and other during August-September.

**Diapause period:** *A. atlas* is in pupal diapause from November to April during extreme cold weather.

### Production parameters

**Oviposition:** Average oviposition per female in *Attacus atlas* silkworm was recorded to be  $197.6 \pm 9.79$ .

**ERR:** Effective Rate of Rearing (EER) of *Attacus atlas*, i.e., the survival rate, was calculated to be  $42.2 \pm 6.30\%$ , which was calculated as number of cocoons harvested/ number of worms reared x 100.

**Cocoon yield:**  $26.4 \pm 3.85$  number of cocoons were harvested from one batch, i.e., eggs laid by a single female moth.

### REFERENCES

- ARORA, G.S. & I.J. GUPTA (1979): Taxonomic studies of some of the Indian non-mulberry silk moths (Lepidoptera: Saturniidae). *Memoirs Zoological Survey, India* 16: 1-63.
- BHATTACHARYA, A., B.K. SINGH & P.K. DAS (2004): Biodiversity of wild silk moths in Assam (North-East India). *Annals of Forestry* 12(2): 208-216.
- CHOWDHURY, S.N. (1981): Muga Silk Industry *In: Muga Silk Industry*. Directorate of Sericulture (Ed.), Govt. of Assam, Guwahati, Assam. Pp. 1-177.
- CHUTIA, B.C., L.N. KAKATI & K.C. SINGH (2009): Biodiversity of wild silk moths in Nagaland. *J. Bombay Nat. Hist. Soc.* 106(1): 112-117.
- JOLLY, M.S., S.K. SEN, T.N. SONWALKAR & G.K. PRASHAD (1979): Non-Mulberry Sericulture. *In: Manual of Sericulture*. Published by Food and Agriculture Organization of United Nation and reprint by Central Silk Board (1987) Rome, FAO. 4(29): 1-119.
- LAMPE, R.E.J. (1984): Die Saturniiden der Cameron-und Genting-Highlands in West Malaysia (Lepidoptera: Saturniidae). *Neue Entomologische Nachrichten* 11: 16. 8 col. pls.
- PEIGLER, R.S. (1989): A revision of the Indo-Australian genus *Attacus*. Lepidoptera Research Foundation, Inc. Beverly Hills, California, U.S.A. Pp. 1-169.
- SAHU, A.K. & B.B. BINDROO (2007): Wild silk moth Biodiversity in the North-Eastern Region of India: Need for Conservation. *Indian Silk* (June): 16-19.
- SAIKIA, B. & R. HANDIQUE (2000): Biology of a wild silk moth, *Attacus atlas* L. *International Journal of Wild Silk Moths and Silk* 5: 345-347.
- SINGH, K.C. & R. CHAKRAVORTY (2006): Seri-biodiversity of North-Eastern India – an update. Pp. 8-19. *In: Handique, J.P. & M.C. Kalita* (Eds): Biodiversity Conservation and Future Concern. Gauhati University, Guwahati.
- SINGH, K.C. & N. SURYANARAYANA (2005): Wild silk moth wealth of India. Pp. 419-421. *In: Dandin, S.B., R.K. Misra, V.P. Gupta & Y.S. Reddy* (Eds): Advances in Tropical Sericulture. Central Sericultural Research & Training Institute, Mysore.
- THANGAVELU, K. (1991): Wild sericigenous insect of India – a need for conservation. *J. Wild Silk moths* 91: 71-77.

